1 Introduction

The AGL Sensor is a small, lightweight laser rangefinder with integrated power and communications interfaces for easy integration into UAV systems. This document describes the external interface.

Table 1, Document Change Log

4-4-08	Added note on ATN line
5-15-08	Added specifications and installation section

2 Specifications

Max Range: The stationary range is 0 to 3,280 ft (1,000 m) typical; 6,560 ft (2,000 m) max to reflective target. During flight testing over varied terrain, a practical maximum range of 400 m was achieved, which allows for vegetation, terrain undulation, and aircraft speed.

Range Accuracy: +/- 1 ft (+/- 30 cm), high quality reading; +/- 1 yd (+/- 1 m), low quality reading

Eye safety: FDA Class 1 (CFR 21)

Temperature: -4°F to +140°F (-20°C to +60°C)

Beam divergence: 3 mrad

3 Installation and use

The AGL Sensor must be installed with the optics face normal to the Z axis of the aircraft, pointing down. The face of the laser should be flush with the outside of the fuselage. If a shroud is necessary, allow for 5mm clearance around the lenses at the face and for 3 mrad beam divergence.

Piccolo autopilot firmware 2.0.4 or later must be used.

To enable, select the “Lat Eng Laser” protocol on the com port to which the sensor is connected. Check that the baud rate has changed to “9600”.

It is important to note that the AGL reading displayed by the Piccolo Command Center or Operator Interface is the kalman filter estimate output, not the raw sensor output.

The AGL Sensor is used by the Piccolo as a control input during the final approach of an autonomous landing. In the 2.1.X versions and beyond, Cloud Cap is planning on implementing an “AGL Hold” control mode, which will also utilize the AGL Sensor readings.

4 Physical Interface

4.1 Electrical Interface

A single three wire RS-232 serial at 9600 bits per second is used to transfer data.

Supplied power may be 7 to 36VDC.

The AGL sensor has a 9-pin female D-Shell connector.

The ATN line is only used for programming, and should be left disconnected in normal use.

Table 2, main connector pin out

Pin	Description
1	No connect
2	TX
3	RX
4	ATN (no connect in use)
5	Communications ground
6	No connect
7	No connect
8	Power ground
9	Vin (7-36 VDC)

4.2 Dimensions

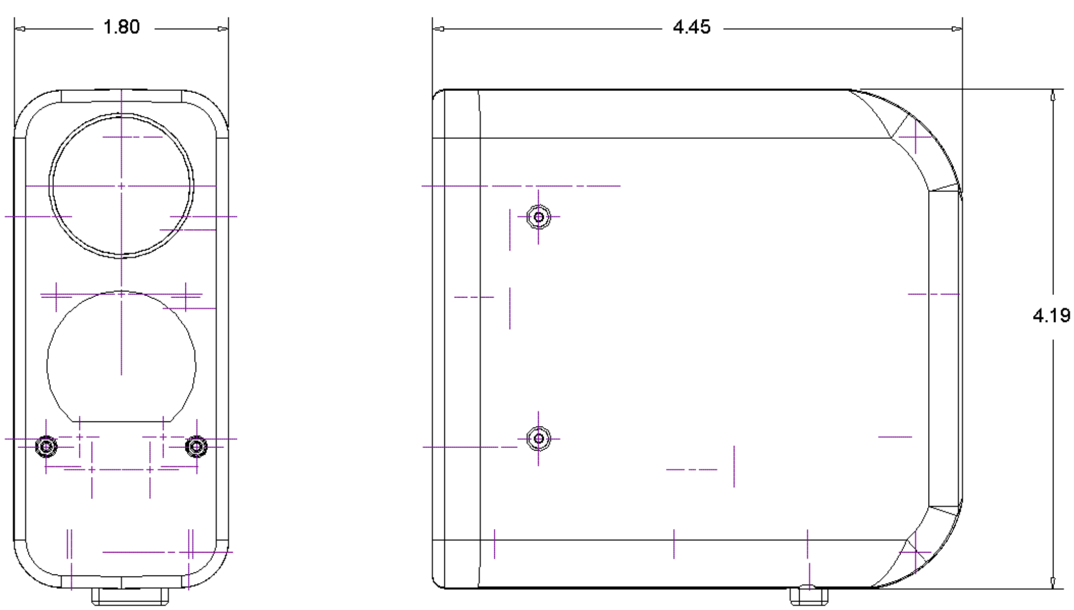

Figure 1, AGL sensor dimensions (inches)

Datalink layer

4.3 General packet definition

All communications take place using packets whose general format is described Table 3 below. Note that all multi-byte values are always sent with the most significant byte first, i.e. in Big-Endian order. This document identifies the bit order of a word as starting at 0 which is the left-most or most-significant bit (MSB).

Table 3, datalink layer packet definition

Byte	Name	Meaning
0	SYNC1	First synchronization character used to signal the receiving state machine that a packet *may* be forthcoming. Must be 0xFF.
1	SYNC2	Second synchronization character used to signal the receiving state machine that a packet *may* be forthcoming. Must be 0x5A.
2	PktType	The packet type.
3	Size	Number of data bytes in the packet.
4…Size+3	Data	Data of the packet
Size+4	Check_0	Most and least significant bytes of the fletchers checksum. The checksum is formed from byte 0 up to and including the last data byte
Size+5	Check_1	

4.4 Packet Types

Table 4 lists the different packet types recognized by the AGL sensor.

Table 4, Data Packet types

Name	Type	Meaning
READING	0x00	Contains the data from a single reading
LASER_MODE	0x01	Sends sensor setting information for the laser sensor
SINGLE	0x02	Requests a single laser reading

5 Packets

5.1 READING

The READING packet contains the data from a single AGL measurement.

Table 5, READING packet

Byte	Name	Meaning
0	Flags	8-bit flags Bit 0 (MSB): Reading is bad Bit 1: Reserved Bit 2: Reading is high resolution, else low Bit 3: Reading is nearest target Bit 4: Reading is farthest target Bit 5-7: Reserved
1	Range_0	24-bit unsigned laser range in millimeters.
2	Range_1	
3	Range_2	

LASER_MODE

The LASER_MODE command packet sends the desired settings to the AGL sensor. Upon receipt of the LASER_MODE request, the sensor will echo the LASER_MODE packet. Either Nearest or Farthest mode must be selected, but not both. If both bits are hi, Nearest mode will be selected. If both bits 1 and 2 are low, no change will be made to the target mode.

Table 6, LASER_MODE packet

Byte	Name	Meaning	
0	Flags	8-bit flags Bit 0 (MSB): Set continuous readings on(1) or off (0) Bit 1: Nearest target mode Bit 2: Farthest target mode Bit 3-7: Reserved	
1	Period	Indicates desired period of the measurement, in 50ms units. A value of 5, for example, will result in a measurement period of 250ms or 4 Hz. This allows measurement periods from 50ms (20Hz) to 12.75s. If longer measurement periods are required, use the SINGLE packet to take individual readings. The current revision of the sensor supports speeds up to 1Hz.	
		Special Cases:	
		0xFF	No change
2	Reserved		

5.2 SINGLE

The SINGLE command packet will request a single READING packet from the AGL sensor. To minimize delay in returning the measurement, the sensor will use the settings currently in memory. Use the MODE packet to change settings.

Table 7, SINGLE packet

Byte	Name	Meaning	
0	REQUEST	0x05	Requests the AGL sensor to take a reading and return a single READING packet.

6 Appendix, The 8-bit Fletcher Checksum Algorithm

The 8-bit Fletcher Checksum Algorithm is calculated over a sequence of data octets (call them D[1] through D[N]) by maintaining 2 unsigned 1's-complement 8-bit accumulators A and B whose contents are initially zero, and performing the following loop where i ranges from:

1 to N:

A = A + D[i]

B = B + A

It can be shown that at the end of the loop A will contain the 8-bit 1's complement sum of all octets in the datagram, and that B will contain (N)D[1] + (N-1)D[2] + ... + D[N].

From: http://tools.ietf.org/html/rfc1146